

Application Serial No. 10/649,311

Amended Claims

Claim 1 (currently amended): A method of forming a capacitor sequentially comprising:

forming an inwardly-tapered-sidewall spacer within an opening of a capacitor ~~electrode-forming~~ electrode-forming layer;
anisotropically etching the spacer;
after etching the spacer, depositing a first capacitor electrode layer over the inwardly-tapered-sidewall spacer within the opening; and
forming a capacitor dielectric region and then a second capacitor electrode layer over the first capacitor electrode layer.

Claim 2 (original): The method of claim 1 wherein the inwardly-tapered-sidewall spacer comprises TiN.

Claim 3 (currently amended): The method of claim 2 wherein the capacitor ~~electrode-forming~~ electrode-forming layer comprises ~~polysilicon~~ borophosphosilicate glass.

Claim 4 (original): The method of claim 2 further comprising removing at least a portion of the inwardly-tapered-sidewall spacer after the depositing, the removing comprising exposing the inwardly-tapered-sidewall spacer to a mixture comprising H_2SO_4 and H_2O_2 , the mixture having a weight ratio of H_2SO_4 to H_2O_2 of about 2:1.

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Claim 5 (withdrawn): The method of claim 1 wherein the inwardly-tapered-sidewall spacer comprises polysilicon.

Claim 6 (withdrawn): The method of claim 5 wherein the first capacitor electrode layer comprises TiN.

Claim 7 (withdrawn): The method of claim 6 further comprising, after depositing the first capacitor electrode layer, removing at least a portion of the inwardly-tapered-sidewall spacer, the removing comprising exposing the inwardly-tapered-sidewall spacer to TMAH.

Claim 8 (original): The method of claim 1 wherein the opening comprises sidewalls and the inwardly-tapered-sidewall spacer resides over at least upper portions of the sidewalls.

Claim 9 (original): The method of claim 1 wherein the opening comprises sidewalls and the inwardly-tapered-sidewall spacer resides over an entirety of the sidewalls.

Claim 10 (withdrawn): The method of claim 1 wherein the opening comprises sidewalls and the inwardly-tapered-sidewall spacer resides over less than an entirety of the sidewalls.

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Claim 11 (currently amended): The method of claim 1 wherein the opening comprises sidewalls and the capacitor ~~electrode-forming~~ electrode-forming layer comprises an elevationally outermost surface proximate the opening, the sidewalls including straight linear portions which are angled from normal to the elevationally outermost surface.

Claim 12 (original): The method of claim 11 wherein the straight linear portions are angled at least 5 degrees from normal to the elevationally outermost surface.

Claim 13 (original): The method of claim 11 wherein the straight linear portions are angled at least 10 degrees from normal to the elevationally outermost surface.

Claim 14 (original): The method of claim 11 wherein the straight linear portions are angled at least 15 degrees from normal to the elevationally outermost surface.

Claim 15 (withdrawn): The method of claim 11 wherein the sidewall spacer comprises laterally inner sidewall portions, the laterally inner sidewall portions including straight linear portions which are angled normal to the elevationally outermost surface.

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Claim 16 (original): The method of claim 1 further comprising removing at least a portion of the inwardly-tapered-sidewall spacer after the depositing and prior to forming the capacitor dielectric region.

Claim 17 (currently amended): A method of forming a capacitor comprising:

providing a substrate having a capacitor ~~electrode-forming~~ electrode-forming layer thereon, the capacitor ~~electrode-forming~~ electrode-forming layer having an opening;

forming a sidewall spacer within the opening, the sidewall spacer being laterally thicker at an elevationally outer portion within the opening as compared to an elevationally inner portion within the opening;

anisotropically etching the spacer;

after anisotropically etching the spacer, forming a first capacitor electrode layer within the opening laterally over the sidewall spacer; and

removing at least a portion of the sidewall spacer and thereafter forming a capacitor dielectric region and a second capacitor electrode layer over the first capacitor electrode layer.

Claim 18 (original): The method of claim 17 wherein the sidewall spacer comprises TiN.

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Claim 19 (original): The method of claim 18 wherein the forming the sidewall spacer comprises flowing TiCl_4 and NH_3 to the substrate to form TiN , the TiCl_4 and NH_3 being flowed at a volumetric ratio of TiCl_4 to NH_3 of from about 1:1 to about 4:1.

Claim 20 (original): The method of claim 18 wherein the removing at least a portion of the sidewall spacer comprises exposing the spacer to a mixture comprising H_2SO_4 and H_2O_2 , the mixture having a weight ratio of H_2SO_4 to H_2O_2 of about 2:1.

Claim 21 (withdrawn): The method of claim 18 wherein first capacitor electrode layer comprises polysilicon.

Claim 22 (withdrawn): The method of claim 18 wherein the sidewall spacer comprises polysilicon and the first capacitor electrode layer comprises TiN .

Claim 23 (withdrawn): The method of claim 22 wherein the removing at least a portion of the sidewall spacer comprises exposing the spacer to TMAH.

Claim 24 (original): The method of claim 17 wherein the opening comprises sidewalls and the sidewall spacer is formed over at least upper portions of the sidewalls.

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Claim 25 (original): The method of claim 17 wherein the opening comprises sidewalls and the sidewall spacer is formed over an entirety of the sidewalls.

Claim 26 (currently amended): The method of claim 17 wherein the opening comprises sidewalls and the capacitor ~~electrode-forming~~ electrode-forming layer comprises an elevationally outermost surface proximate the opening, the sidewalls including straight linear portions which are angled from normal to the elevationally outermost surface.

Claim 27 (original): The method of claim 26 wherein the straight linear portions are angled at least 5 degrees from normal to the elevationally outermost surface.

Claim 28 (original): The method of claim 26 wherein the straight linear portions are angled at least 10 degrees from normal to the elevationally outermost surface.

Claim 29 (original): The method of claim 26 wherein the straight linear portions are angled at least 15 degrees from normal to the elevationally outermost surface.

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Claim 30 (original): The method of claim 26 wherein the sidewall spacer comprises laterally inner sidewall portions, the laterally inner sidewall portions including straight linear portions which are angled normal to the elevationally outermost surface.

Claim 31 (original): The method of claim 17 wherein the removing comprises removing at least a majority of the sidewall spacer.

Claim 32 (original): The method of claim 17 wherein the removing comprises removing substantially all of the sidewall spacer.

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Claim 33 (currently amended): A method of forming a capacitor comprising:

forming an opening within a capacitor ~~electrode-forming~~ electrode-forming layer over a substrate, the opening comprising sidewalls;

depositing a spacing layer over the capacitor ~~electrode-forming~~ electrode-forming layer to within the opening over at least upper portions of the sidewalls, the depositing forming the spacing layer to be laterally thicker at an elevationally outer portion within the opening as compared to an elevationally inner portion within the opening;

anisotropically etching the spacing layer to form a spacer within the opening, the spacer being laterally thicker at an elevationally outer portion within the opening as compared to an elevationally inner portion within the opening;

forming a first capacitor electrode layer within the opening laterally over the spacer; and

after forming the first capacitor electrode layer, removing at least a portion of the spacer and thereafter forming a capacitor dielectric region and a second capacitor electrode layer over the first capacitor electrode layer.

Claim 34 (currently amended): The method of claim 33 wherein the capacitor ~~electrode-forming~~ electrode-forming layer comprises borophosphosilicate glass.

Claim 35 (original): The method of claim 33 wherein the spacing layer comprises TiN.

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Claim 36 (withdrawn): The method of claim 35 wherein the first capacitor electrode layer comprises polysilicon.

Claim 37 (original): The method of claim 35 wherein the removing at least a portion of the spacer comprises exposing the spacer to a mixture comprising H_2SO_4 and H_2O_2 , the mixture having a weight ratio of H_2SO_4 to H_2O_2 of about 2:1.

Claim 38 (original): The method of claim 35 wherein the depositing the spacing layer comprises flowing TiCl_4 and NH_3 to the substrate to form TiN .

Claim 39 (original): The method of claim 38 wherein the TiCl_4 and NH_3 are flowed to the substrate simultaneously at a volumetric ratio of TiCl_4 to NH_3 of less than 4:1.

Claim 40 (original): The method of claim 38 wherein the TiCl_4 and NH_3 are flowed to the substrate simultaneously at a volumetric ratio of TiCl_4 to NH_3 of from about 1:1 to about 3:1.

Claim 41 (original): The method of claim 38 wherein the TiCl_4 and NH_3 are flowed to the substrate simultaneously at a volumetric ratio of TiCl_4 to NH_3 of about 1:1.

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Claim 42 (withdrawn): The method of claim 33 wherein the spacing layer comprises polysilicon and the first capacitor electrode layer comprises TiN.

Claim 43 (withdrawn): The method of claim 42 wherein the removing at least a portion of the spacer comprises exposing the spacer to TMAH.

Claim 44 (original): The method of claim 33 wherein the depositing the spacing layer occurs at a pressure of greater than 10 Torr.

Claim 45 (withdrawn): The method of claim 33 wherein the depositing the spacing layer occurs at a pressure of from 10 Torr to 20 Torr.

Claim 46 (original): The method of claim 33 wherein the depositing the spacing layer occurs at a pressure of greater than about 20 Torr.

Claim 47 (original): The method of claim 33 wherein the depositing the spacing layer occurs at a temperature of at least 600°C.

Claim 48 (withdrawn): The method of claim 33 wherein the depositing the spacing layer occurs at a temperature of from 600°C to 700°C.

Claim 49 (original): The method of claim 33 wherein the depositing the spacing layer occurs at a temperature of at least 700°C.

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Claim 50 (original): The method of claim 33 wherein the depositing the spacing layer comprises depositing the spacing layer over an entirety of the sidewalls.

Claim 51 (withdrawn): The method of claim 33 wherein the depositing the spacing layer comprises depositing the spacing layer over less than an entirety of the sidewalls.

Claim 52 (withdrawn): The method of claim 33 wherein the etching forms the spacer over an entirety of the sidewalls.

Claim 53 (withdrawn): The method of claim 33 wherein the etching forms the spacer over less than an entirety of the sidewalls.

Claim 54 (currently amended): The method of claim 33 wherein the capacitor ~~electrode-forming~~ electrode-forming layer comprises an elevationally outermost surface proximate the opening, the sidewalls including straight linear portions which are angled from normal to the elevationally outermost surface.

Claim 55 (original): The method of claim 54 wherein the straight linear portions are angled at least 5 degrees from normal to the elevationally outermost surface.

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Claim 56 (original): The method of claim 54 wherein the straight linear portions are angled at least 10 degrees from normal to the elevationally outermost surface.

Claim 57 (original): The method of claim 54 wherein the straight linear portions are angled at least 15 degrees from normal to the elevationally outermost surface.

Claim 58 (original): The method of claim 54 wherein the spacer comprises laterally inner sidewall portions, the laterally inner sidewall portions including straight linear portions which are angled normal to the elevationally outermost surface.

Claim 59 (original): The method of claim 33 wherein the removing comprises removing at least a majority of the spacer.

Claim 60 (original): The method of claim 33 wherein the removing comprises removing substantially all of the sidewall spacer.